



ATTO Technology, Inc.

Installation and Operation Manual

Celerity FC Storage Adapters

Celerity FC-42ES

4-Gb FC dual channel storage adapter

Celerity FC-44ES

4-Gb FC quad channel storage adapter

Celerity FC-42XS

4-Gb FC dual channel storage adapter

Celerity FC-41XS

4-Gb FC single channel storage adapter

Celerity FC-21PS

2-Gb FC single channel storage adapter

Celerity FC-22XH

2-Gb FC dual channel storage adapter with onboard hub

Celerity FC-24XL

2-Gb FC quad channel storage adapter with IOPC architecture

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1 ATTO provides Fibre Channel solutions

The ATTO Celerity Fibre Channel family of storage products provides connectivity, intelligence and scalability. Celerity FC storage adapters simplify advanced storage networking needs such as switching, backup and data management. Specifically designed to enhance the functionality of third party fabric hardware and software, Celerity FC products are the industry-leading platform for storage connectivity

Celerity FC-42ES Adapter

The Celerity FC-42ES is a dual-channel storage adapter, providing port density for Enterprise server and workstation applications. The FC-42ES leverages two next-generation storage technologies: PCI Express interconnect and 4-Gigabit Fibre Channel. With 4-Gb FC speeds of up to 800 MB/second per channel, the FC-42ES supports the most demanding application requirements, including high-definition video, rich content databases and other high-bandwidth environments.

Additionally the FC-42ES takes advantage of the latest in host interconnect technology, PCI Express, a serial, high-speed connection that supports aggregate throughput up to 2 GB/second (x8 PCIe). The FC-42ES is software compatible with existing PCI and PCI-X products using the same device drivers as the other Celerity FC family products, simplifying user installation and support.

The Celerity FC-42ES is backward compatible with existing 2-Gb and 1-Gb Fibre Channel infrastructure, protecting existing technology investments.

Hardware specifications

- 2 independent Fibre Channel ports
- 4-Gigabit data transfer rates per channel
- 800 MB/sec. maximum full-duplex throughput per channel
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- ANSI Fibre Channel: FC-PH, FC-FCP, FC, FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA
- Flash ROM for easy field upgrades
- FC Class 3 support
- Local management and diagnostics

- Buffer credits: 8 @ 512 Bytes; 8 @ 2kB

Advanced FC capabilities

- Supports SNIA HBA API
- On-demand automatic negotiation among 4-Gb, 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes
- Supports Windows® FDMI and WMI
- Supports Exclusive Advanced Data Streaming (ADS™) Technology

Host bus specifications

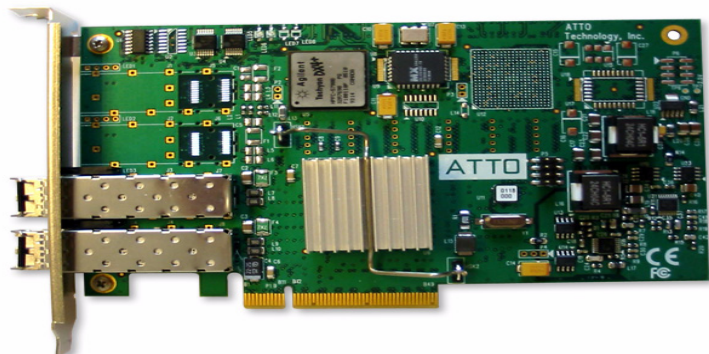
- x8 mechanical and x8 electrical PCI Express Interconnect
- Conforms to PCI Express Base Spec 1.0a
- Conforms to PCI Express CEM Spec 1.0a
- PCI to PCI/PCI-X Bridge spec 1.0

Environmental & physical specifications

- Conforms to PCI standard height, half length form-factor specifications
- Length: 6.525 inches
- Height: 3.81 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- 12V@ .035A (max.)
- 3.3V @ 1.42A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install full height connection plate



- External LEDs for on-line and speed status for each channel
- Two pluggable optical LC SFP transceivers included

Celerity FC-44ES Adapter

The Celerity FC-44ES leverages two next-generation storage technologies: PCI Express Interconnect and 4-Gigabit Fibre Channel.

With 4-Gb FC speeds of up to 800 MB/sec. per channel, the FC-44ES supports the most demanding application requirements, including high-definition video, rich content databases and other high bandwidth environments.

The FC-44ES takes advantage of the latest in host interconnect technology, PCI Express, a serial, high-speed connection that supports aggregate throughput up to 2.2 GB/sec. (x8PCIe). With software compatible with existing PCI and PCI-X products, the FC-44ES uses the same device drivers as the other Celerity FC family products, simplifying installation and support.

Hardware specifications

- Four independent Fibre Channel ports
- 4-Gigabit data transfer rates per channel
- 800 MB/sec. maximum full-duplex throughput per channel
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- ANSI Fibre Channel: FC-PH, FC-FCP, FC FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA
- Flash ROM for easy field upgrades
- FC Class 3 support
- Local management and diagnostics
- Buffer credits: 8 @ 512 Bytes; 8 @ 2kB

Advanced FC capabilities

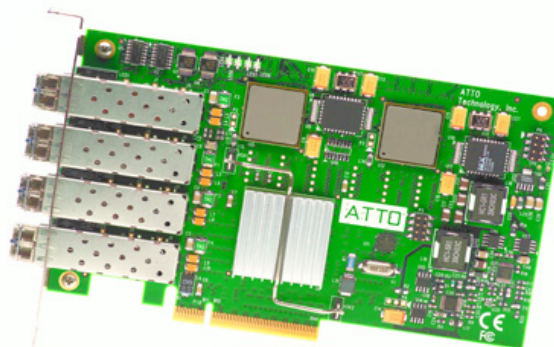
- Supports SNIA HBA API
- On-demand automatic negotiation among 4-Gb, 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes
- Supports Windows FDMI and WMI
- Supports Exclusive Advanced Data Streaming (ADS™) Technology

Software specifications

- Windows XP, 2000 and Server 2003
- Red Hat Linux® (2.4 and 2.6 kernel)
- SUSE® Linux (2.6 kernel)

Host bus specifications

- x8 mechanical and x8 electrical PCI Express Interconnect



- Conforms to PCI Express Base Spec 1.0a
- Conforms to PCI Express CEM Spec 1.0a
- PCI to PCI/PCI-X Bridge spec 1.0

Environmental & physical specifications

- Conforms to PCI standard height, half length form-factor specifications
- Length: 6.525 inches
- Height: 3.81 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- 12V@ 2.1A (max.)
- 3.3V @ 3.0A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install full height connection plate
- External LEDs for on-line and speed status for each channel
- Four pluggable optical LC SFP transceivers included

Software specifications

- Windows XP, 2000 and Server 2003
- Red Hat Linux (2.4 and 2.6 kernel)
- SUSE Linux (2.6 kernel)

Celerity FC-42XS Adapter

The dual-channel Celerity FC-42XS storage adapter provides the highest available throughput for Fibre Channel applications while protecting technology investments via backward compatibility with existing infrastructure.

With speeds of up to 800 MB/sec. per channel, the FC-42XS is capable of supporting the most intensive data applications, including digital content creation, tape streaming and backup, rich content delivery and complete database environments.

To ensure a smooth transition path, the FC-42XS leverages the existing Celerity FC software hardware architecture, allowing ATTO to deliver industry-leading quality and stable software architecture.

Hardware specifications

- Two independent Fibre Channel ports
- 4-Gigabit data transfer rates per channel
- 800 MB/sec. maximum full-duplex throughput per channel
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- ANSI Fibre Channel: FC-PH, FC-FCP, FC FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA
- Flash ROM for easy field upgrades
- FC Class 3 support
- Local management and diagnostics
- Buffer credits: 8 @ 152 bytes; 8 @ 2k bytes

Advanced FC capabilities

- Supports SNIA HBA API
- On-demand automatic negotiation among 4-Gb, 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes
- Supports Windows FDMI and WMI
- Exclusive Advanced Data Streaming (ADS™) Technology

PCI bus specifications

- 64-bit, 133 MHz PCI-X
- PCI-X 1.0a compliant
- PCI 2.2 compliant
- 3.3V PCI signaling only



Environmental & physical specifications

- Conforms to PCI low profile form factor standards
- Length: 6.600 inches
- Height: 2.536 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- 5V@ 1.5A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install full height connection plate
- External LEDs for on-line and speed status for each channel
- Two optical LC SFP transceivers included

Software specifications

- Windows XP, 2000, Server 2003
- Red Hat Linux (2.4 and 2.6 kernel)
- SUSE Linux (2.6 kernel)
- Mac® OS X

Celerity FC-41XS Adapter

The single-channel Celerity FC-41XS is the next-generation of ATTO advanced storage connectivity solutions, leveraging the latest in storage technology: 4-Gigabit Fibre Channel. With speeds of up to 800 MB/sec., the FC-41XS is capable of supporting the most data-intensive applications such as digital content creation, tape streaming, backup rich content delivery and complex database environments. Additionally the FC-41XS leverages existing Celerity FC software and hardware architectures, allowing ATTO to deliver cutting-edge performance with top-notch quality and design stability. Providing cost-effective connectivity for client and server applications alike, the FC-41XS offers full 4-Gigabit performance as well as full backward compatibility with existing 2-Gb and 1-Gb Fibre Channel infrastructure, protecting existing technology investments.

Hardware specifications

- One Fibre Channel port
- 4-Gigabit FC data transfer rates per channel
- 800 MB/sec. maximum full-duplex throughput.
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- ANSI Fibre Channel: FC-PH, FC-FCP, FC FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA
- Flash ROM for easy field upgrades
- FC Class 3 support
- Local management and diagnostics
- Buffer credits: 8 @ 152 bytes; 8 @ 2k bytes

Advanced FC capabilities

- Supports SNIA HBA API
- On-demand automatic negotiation among 4-Gb, 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes

- Supports Windows FDMI and WMI
- Exclusive Advanced Data Streaming (ADS™) Technology

PCI bus specifications

- 64-bit, 133 MHz PCI-X
- PCI-X 1.0a compliant
- PCI 2.2 compliant
- 3.3V PCI signaling only

Environmental & physical specifications

- Conforms to PCI low profile form factor standards
- Length: 6.600 inches
- Height: 2.536 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- 5V@ 1.5A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install full height connection plate
- External LEDs for on-line and speed status
- One optical LC SFP transceiver included

Software specifications

- Windows XP, 2000, Server 2003
- Red Hat Linux (2.4 and 2.6 kernel)
- SUSE Linux (2.6 kernel)
- Mac OS X



Celerity FC-21PS Adapter

The Celerity FC-21PS Fibre Channel Storage Adapter provides a single 2-Gb Fibre Channel connection from host devices to the Storage Area Network (SAN) fabric.

The FC-21PS supports the leading operating systems, providing a single solution for all connectivity needs. As with all Celerity FC products, the FC-21PS is designed for high-quality data transmission, ensuring that critical information is delivered correctly the first time to reduce fabric traffic and improve overall fabric efficiency.

Hardware specifications

- One Fibre Channel port
- 400 MB/sec. throughput in full duplex mode
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- Flash ROM for easy field upgrades
- Simultaneous multi-protocol support
- ANSI Fibre Channel: FC-PH, FC-FCP, FC-FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA, IETF-IPFC

Advanced FC capabilities

- Supports SNIA HBA API
- On-demand, automatic negotiation between 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes
- Supports Windows FDMI and WMI
- Exclusive Advanced Data Streaming (ADS™) Technology

PCI bus specifications

- 64-bit/32-bit, 66/33 MHz PCI compatible
- PCI 2.3 compliant
- 3.3V and 5V PCI signaling with universal connector



Environmental & physical specifications

- Conforms to PCI low profile form factor standards
- Length: 6.600 inches
- Height: 2.536 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- 5V@ 1.5A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install full height connection plate
- Integrated optical LC SFF fixed transceiver
- External LEDs for on-line and speed status

Software specifications

- Windows XP, 2000, Server 2003
- Red Hat Linux (2.4 and 2.6 kernel)
- SUSE Linux (2.6 kernel)
- Mac OS X

Celerity FC-22XH

The Celerity FC-22XH is a Fibre Channel storage adapter which uses embedded hub technology to provide four external connections to two independent FC channels. The hub technology helps simplify SAN fabric design and provides more capabilities than found in a typical adapter.

The FC-22XH allows you to solve cost and configuration issues in workgroup and complex SAN designs. Several users may share Fibre Channel connections to maximize the value of each channel without the added expense of using additional adapters or PCI expansion slots. The FC-22XH design provides reduced total cost of ownership (TCO).

These capabilities are provided without sacrificing link quality. The onboard hub digitally retimes all signals to reduce jitter (poor signal quality) to attached devices. Port bypass circuitry automatically detours around unused or malfunctioning ports.

Hardware specifications

- Four external ports connect to two independent FC channels
- 2.125-Gigabit data transfer rates per channel
- 400 MB/sec. maximum full duplex throughput per channel, shared between ports connected to each channel
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- Flash ROM for easy field upgrades
- Simultaneous multi-protocol support
- ANSI Fibre Channel: FC-PH, FC-FCP, FC-FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA, IETF-IPFC

Advanced FC capabilities

- Supports SNIA HBA API
- On-demand, automatic negotiation between 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes
- Supports Windows FDMI and WMI
- Exclusive Advanced Data Streaming (ADSTM) Technology

PCI bus specifications

- 64-bit, 133 MHz PCI-X

- 64/32-bit, 100/66/33 MHz PCI compatible
- PCI 2.3 compliant
- 3.3V PCI signaling only

Environmental & physical specifications

- Conforms to PCI full form factor standards
- Length: 6.600 inches
- Height: 3.800 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- 3.3V@2.0A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install connection plate
- Up to four shortwave optical LC SFP pluggable transceivers
- Two optical LC SFP transceivers included
- External LEDs indicate on-line and speed status for each channel

Software specifications

- Windows XP, 2000, Server 2003
- Red Hat Linux (2.4 and 2.6 kernel)
- SUSE Linux (2.6 kernel)
- Mac OS X



Celerity FC-24XL

The Celerity FC-24XL is a Fibre Channel advanced storage adapter with four independent channels of 2-Gb connectivity and advanced functions. The FC-24XL is a platform with embedded processing and buffering capabilities to enable data stream manipulation, direct port-to-port transfers, offload processing, video handling and myriad other capabilities.

At the heart of the FC-24XL is the Integrated Offload & Processing Center (IOPC) using an Intel XScale® processor core and an internal 133 MHz PCI-X data bus for top performance and low latency. IOPC simplifies and augments SAN fabric management, including:

- Port-to-port data streaming
- Hardware RAID
- Backup offload
- Metadata insertion
- Data protection
- Video handling

Hardware specifications

- Four independent data channels, each supporting 2-Gb Fibre Channel performance
- 2.125-Gigabit data transfer rates per channel
- 400 MB/sec. maximum full duplex throughput per channel
- Supports all FC topologies: direct fabric, arbitrated loop and point-to-point
- Flash ROM for easy field upgrades
- Simultaneous multi-protocol support

IOPC specifications

- Developer's kit for OEMs
- Intel IOP80331XScale processor core
- Supports up to 512 MB DDR 333 MHz SDRAM
- Internal 133 MHz PCI-X bus
- EDC error correction hardware capable of end-to-end data integrity
- ANSI Fibre Channel: FC-PH, FC-FCP, FC-FCP2, FC-AL, FC-AL2, FC-PLDA, FC-FLA, IETF-IPFC

Advanced FC capabilities

- Supports SNIA HBA API
- On-demand, automatic negotiation between 2-Gb and 1-Gb Fibre Channel
- Supports Target and Initiator modes
- Supports Windows FDMI and WMI

- Exclusive Advanced Data Streaming (ADS™) Technology

PCI Bus Specifications

- 64-bit, 133 MHz PCI-X
- 64/32-bit, 100/66/33 MHz PCI compatible
- PCI-X 1.0a compliant
- PCI 2.3 compliant
- 3.3V PCI signaling only

Environmental & physical specifications

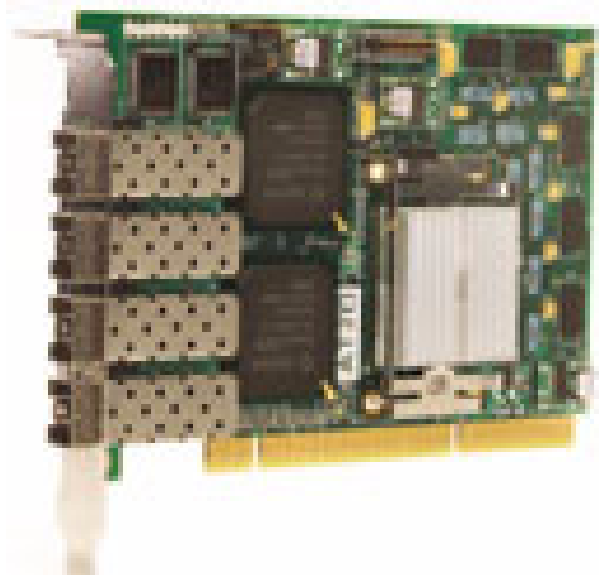
- Conforms to PCI full form factor standards
- Length: 6.600 inches
- Height: 4.200 inches
- Operating Temperature: 0-45°C (32°-113°F)
- Storage Temperature: -40° to 70°C (-40° to 158°F)
- Relative Humidity: 5 to 95% non-condensing
- +3.3 V@4.0A (max.)
- 100 lf/m (minimum) airflow recommended

External connectivity

- Easy-to-install connection plate
- Up to four shortwave optical LC SFP pluggable transceivers
- Two optical LC SFP transceivers included
- External LEDs to show on-line and speed status for each channel

Software specifications

- Windows XP, 2000, Server 2003
- Red Hat Linux (2.4 and 2.6 kernel)
- SUSE Linux (2.6 kernel)
- Mac OS X



Celerity Selection Guide

Celerity FC Storage Adapters

Product Features	Celerity FC-44ES	Celerity FC-42ES	Celerity FC-42XS	Celerity FC-41XS	Celerity FC-24XL	Celerity FC-22XH	Celerity FC-21PS
Fibre Channel Ports	4	2	2	1	4	2-4 ¹	1
FC protocol	4-Gb	4-Gb	4-Gb	4-Gb	2-Gb	2-Gb	2-Gb
Maximum Transfer Rate (half duplex)	1.6 GB/sec	800 MB/sec	800 MB/sec	400 MB/sec	800 MB/sec	400 MB/sec	200 MB/sec
Maximum Transfer Rate (full duplex)	2 GB/sec	1 GB/sec	1 GB/sec ²	800 MB/sec	1 GB/sec ²	800 MB/sec	400 MB/sec
Bus Type	PCIe	PCIe	PCI-X	PCI-X	PCI-X	PCI-X	PCI
Bus Characteristics ³	8 lane	8 lane	64-bit 133 MHz	64-bit 133 MHz	64-bit 133 MHz	64-bit 133 MHz	64-bit 66 MHz
Optical Interface	SFP LC	SFP LC	SFP LC	SFP LC	SFP LC	SFP LC	SFF LC
Maximum Cable Length	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	300m@2-Gb 150m@4-Gb	500m@1-Gb 300m@2-Gb	500m@1-Gb 300m@2-Gb	500m@1-Gb 300m@2-Gb
Advanced Data Streaming (ADS™) Technology	✓	✓	✓	✓	✓	✓	✓
Software RAID Support ⁴	✓	✓	✓	✓	✓	✓	✓
Developer's Kit (Target Mode & API)	✓	✓	✓	✓	✓	✓	✓
Developer's Kit (Advanced)					✓		
Integrated Offload & Processing Center (IOPC)					✓		
Onboard Memory for Direct Memory Transfers					✓		
Integrated Hub Technology						✓	
Windows Support	✓	✓	✓	✓	✓	✓	✓
Linux (Red Hat) Driver Support	✓	✓	✓	✓	✓	✓	✓
Macintosh® OS X (Tiger) Driver Support	NA	NA	✓	✓	✓	✓	✓
¹ ATTO onboard hub technology allows for up to four external connections to two FC channels ² Performance ceiling is constrained by 133 MHz PCI-X bus transfer speed ³ Backward compatible to 32-bit and 33 MHz PCI; FC-24XL and FC-22XH are 3.3V; FC-21PS is 3.3V/5V Universal ⁴ ATTO ExpressStripe for OS X available; other software RAID supported							

2 Fibre Channel is a key technology for storage

Fibre Channel is a serial communications technology designed to transfer large amounts of data among a variety of hardware systems over long distances. It is a key technology for applications that require shared, high bandwidth access to storage.

Fibre Channel provides a logical, point-to-point, serial channel for the transfer of data between a buffer at a source device and a buffer at a destination device. It moves buffer contents from one port to another, without regard to the format or meaning of the data so different upper level

protocols are able to run over Fibre Channel hardware.

The Fibre Channel architecture is structured as a hierarchical set of protocol layers. Defined within these layers are rules for signal interfaces, serial encoding and decoding, error control, frame format and communications protocols.

Glossary

Some terms used in the Fibre Channel industry are defined below. More information is available through the ATTO Technology web site (www.attotech.com), the Fibre Channel Industry Association (www.fibrechannel.com), Cern (www.cern.ch), the Storage Area Networking Industry Association (www.snia.org), and the Fibre Channel Consortium (www.iol.unh.edu/consortiums, click on FC).

Term	Definition
ANSI	American National Standards Institute
arbitrate	process of selecting one L_Port from a collection of ports which ask for use of the arbitrated loop at the same time
arbitrated loop	a loop topology (FC-AL) in which two or more ports are interconnected, but only two ports can communicate at one time; low-cost solution which may or may not use hubs and switches
auto negotiation	hardware senses and automatically responds depending on configuration
BER	Bit Error Rate: a measure of transmission accuracy; the ratio of bits received in error to bits sent
bit	smallest unit of data a computer can process: a single binary digit with a value of either 0 or 1
bus	a collection of unbroken signal lines used to transmit information from one part of a computer system to another; taps on the lines connect devices to the bus
byte	an ordered set of 8 bits
channel	a point-to-point link which transports data from one point to another
CPU	Central Processing Unit: the portion of the computer that actually performs computations
CRC	Cyclic Redundancy Check: an error-correcting code which calculates a numeric value for received and transmitted data; if no error has occurred during transmission, the CRC for both received and transmitted data should be the same
destination address	a value in the frame header of each frame which identifies the port in the node where the frame is being sent
device driver	a program that allows a microprocessor to direct the operation of a peripheral device
DMA	Direct Memory Access: a way to move data from a storage device directly to RAM without using the CPU's resources
DMA bus master	allows a peripheral to control the flow of data to and from system memory by block as opposed to allowing the processor to control the data by bytes (PIO or programmed I/O)

Term	Definition
fabric	a Fibre Channel switch or two or more Fibre Channel switches interconnected to physically transmit data between any two N_Ports on the switch or switches
FC	Fibre Channel
F_port	a port in the Fibre Channel fabric where a N_port may attach
FL_port	a port in the Fibre Channel fabric where a NL_port may attach in an arbitrated loop
frame	an indivisible unit for transfer of information in Fibre Channel
frame header	the first field in the frame containing the address and other control information about the frame
full duplex	a communication protocol which allows transmission in both directions at the same time
half duplex	a communication protocol which allows transmission in both directions, but only one direction at a time
host	a processor, usually a CPU and memory, which communicates with devices over an interface
initiator device	a component which originates a command
L_port	a port in an arbitrated loop, either a NL_port or a FL_port
LED	Light-emitting diode: a type of diode that emits light when current passes through it; visible LEDs are used as indicator lights on all sorts of electronic devices
LUN	Logical Unit Number: an identifier for a logical unit (0-7)
multi-mode fiber	an optical fiber which can carry several beams of light at once
N_port	a port attached to a node used with point to point or fabric configurations
NL_port	a port attached to a node in Fibre Channel arbitrated loop or fabric loop configuration
originator	an initiating device; a component which originates a command
parity checking	a method which verifies the accuracy of data transmitted over the SCSI bus by adding one bit in the transfer to make the sum of all the bits either odd or even (for odd or even parity); an error message occurs if the sum is not correct
PCI	Peripheral Component Interconnect. Allows peripherals to be connected directly to computer memory, bypassing the slower ISA and EISA busses
point-to-point	a topology where two ports communicate
port	an access point in a device: see N_port, NL_port, etc.
port address	also port number; the address, assigned by the PCI bus, through which commands are sent to a storage adapter board
port number	see port address
receiver	the ultimate destination of data transmission; a terminal device
scatter/gather	a device driver feature which allows the storage adapter to modify a transfer data pointer so that a single storage adapter can access many segments of memory, minimizing interrupts and transfer overhead
SCSI	Small Computer Systems Interface: a processor-independent standard for system-level interface between a computer and intelligent devices including hard disks, floppy disks, CD-ROM, printers, scanners, etc.
single-mode fiber	an optical fiber with a small core which supports one wavelength (ray of light); the core radius is nearly equal to the wavelength of the source
topology	logical layout of the parts of a computer system or network and their interconnections
transceiver	a transmitter/receiver module
transfer rate	the rate at which bytes or bits are transferred, as in megabytes or gigabits per second

3 Hardware installation

You need a basic understanding of Fibre Channel before installing the Celerity FC storage adapter. Please refer to [Fibre Channel is a key technology for storage](#) on page 9 for a list of related web sites.



CAUTION

Back up your system data before changing or installing any hardware.

System requirements

The Celerity FC storage adapter package contains the storage adapter, the ATTO Utilities CD and a warranty and registration card. If any of these items are missing, contact your ATTO authorized sales representative.

To install and use the Celerity Fibre Channel storage adapter you need

- A computer with an available PCI, PCI-X or PCI-Express expansion slot.
- The complete Celerity FC storage adapter package.

Fibre Channel address

Celerity FC adapters are configured with a unique address designated by the Institute of Electrical and Electronic Engineers. The WorldWide Port Name (WWN) and Node Name are the two components of the address assigned to Fibre Channel products. This address, stored in flash memory, allows the system to recognize the Celerity Storage Adapter as a unique part of your configuration. The address is clearly marked on the back of the board for easy identification. Please keep a reference copy of the number in a safe place or write in the space provided on this page.

Celerity FC storage adapter WWNs are assigned for each channel. The WWN listed on your storage adapter is assigned to the first channel (0). Sequential WWNs apply for additional channels.

WWN 0: _____
WWN 1: _____ (FC-24XL, FC-44ES, FC-42ES, FC-22XH & FC42-XS)
WWN 2: _____ (FC-24XL, FC44ES)
WWN 3: _____ (FC-24XL, FC-44ES)

Installation



CAUTION

Celerity FC storage adapters contain components that are sensitive to electrostatic discharge (ESD). ESD can cause damage to the Celerity FC storage adapter. Please follow standard methods to avoid ESD.

- 1 Power down the computer and unplug the computer from all power sources.
- 2 Open the case.
- 3 Install the Celerity FC storage adapter in any open PCI, PCI-X or PCI-Express expansion slot. If you have questions about how to install an expansion card in your system, consult your computer's documentation.



Note

The Celerity FC-22XH, Celerity FC-24XL, Celerity FC-41XS, and Celerity FC-42XS storage adapters only fit in 3.3V slots.

The Celerity FC-44ES and FC-42ES fit in 8x or 16x mechanical PCI Express slots.

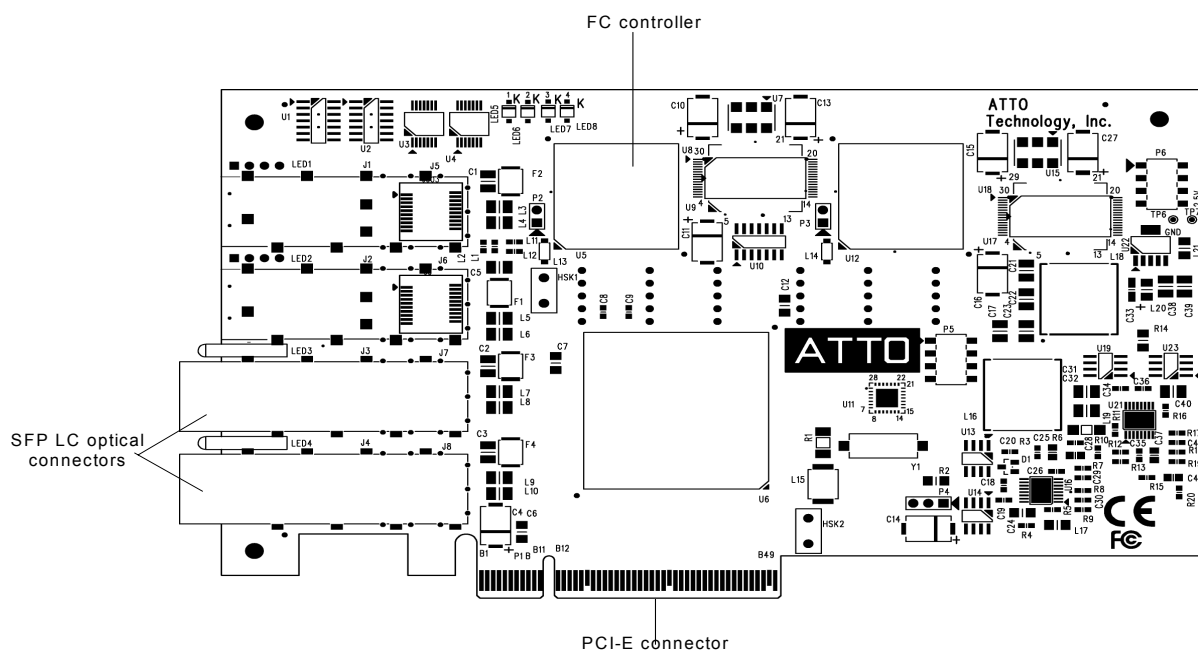
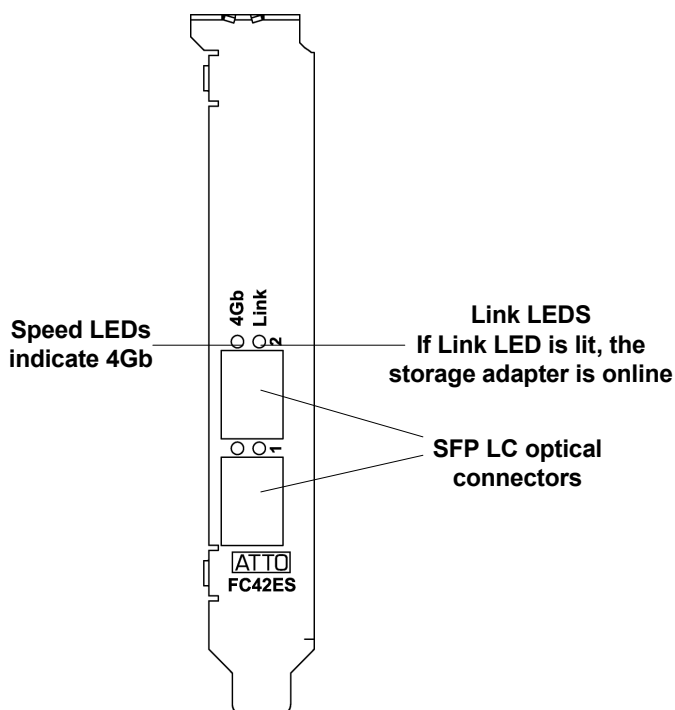
If you have trouble seating your adapter in a 32-bit PCI bus computer, check to make sure the connector can accommodate 64-bit host adapters.

- 4 Connect Fibre Channel devices by inserting a Fibre Channel cable from the devices to the connectors on the Celerity FC storage adapter until you hear a click.
- 5 Close the case on the computer and power it up.

FC-42ES Adapter

The Celerity FC-42ES is a dual-channel storage adapter with a serial, high-speed connection that supports aggregate throughput up to 1 GB/second (x8 PCIe). It features an easy-to-install full height connection plate, external LEDs for on-line and speed status for each channel and two pluggable optical LC SFP transceivers.

The FC-42ES takes advantage of the latest in host interconnect technology, PCI Express, a serial, high-speed connection. With software compatible with existing PCI and PCI-X products, the FC-42ES uses the same device drivers as the other Celerity FC family products, simplifying installation and support.

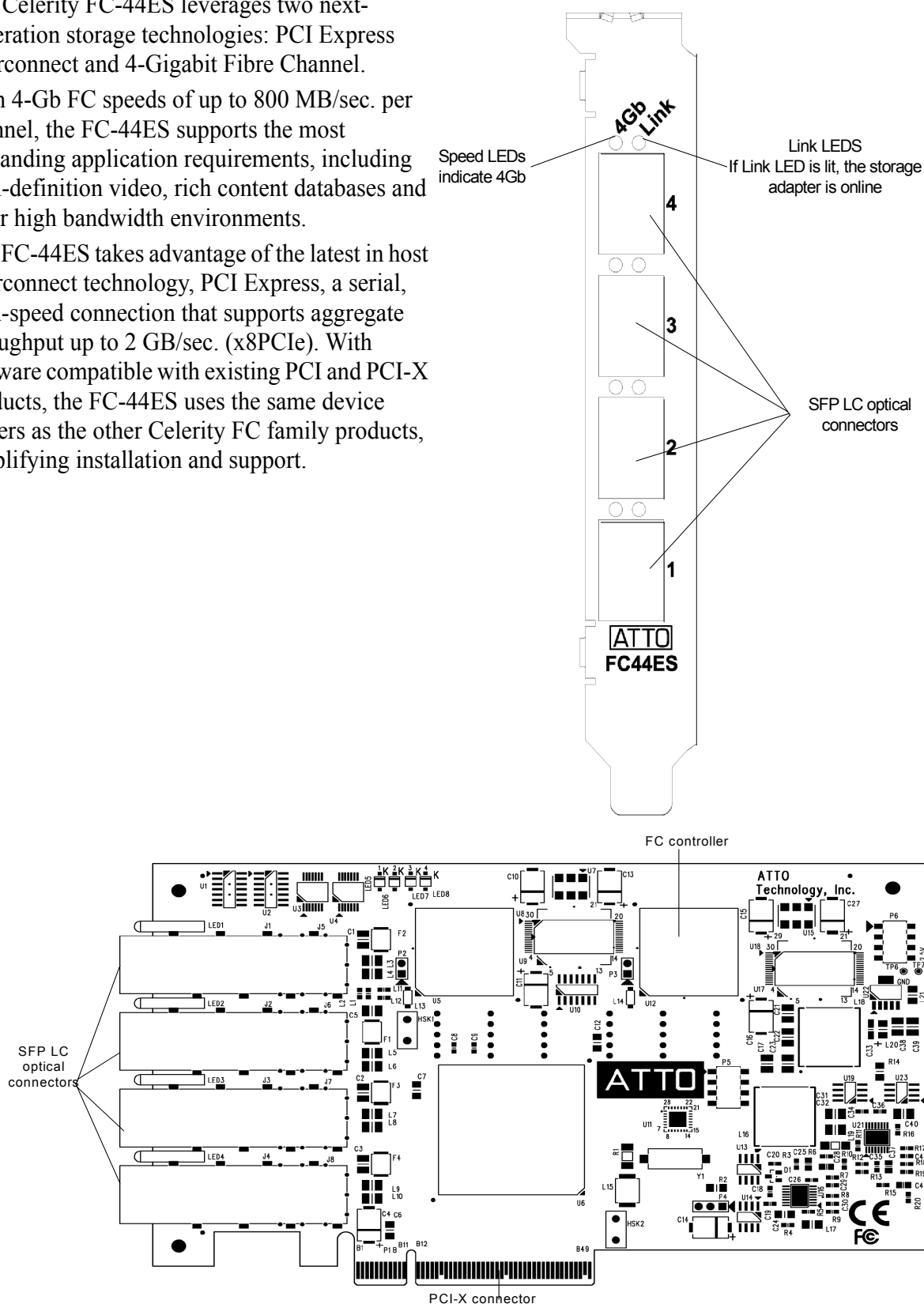


FC-44ES Adapter

The Celerity FC-44ES leverages two next-generation storage technologies: PCI Express Interconnect and 4-Gigabit Fibre Channel.

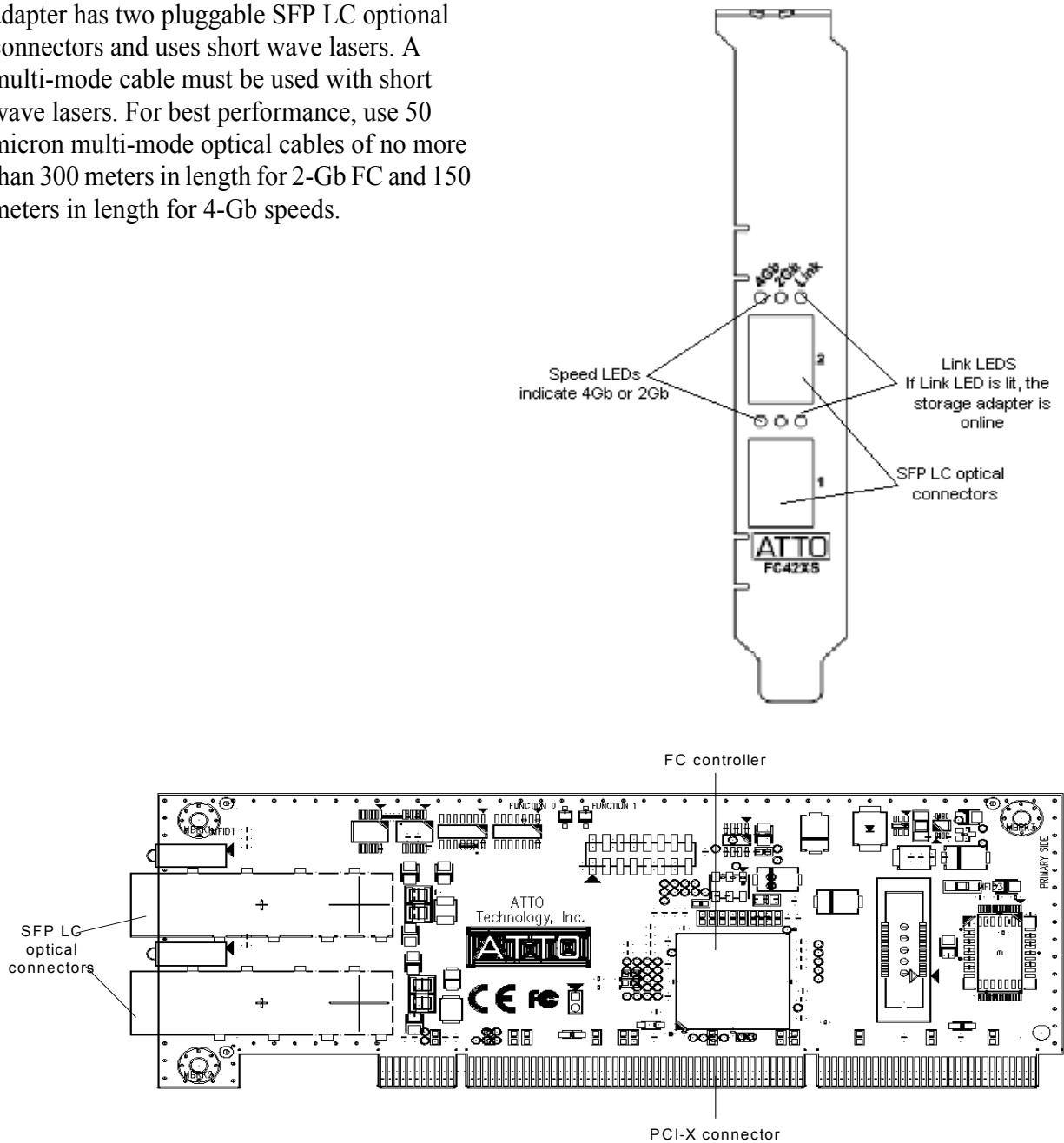
With 4-Gb FC speeds of up to 800 MB/sec. per channel, the FC-44ES supports the most demanding application requirements, including high-definition video, rich content databases and other high bandwidth environments.

The FC-44ES takes advantage of the latest in host interconnect technology, PCI Express, a serial, high-speed connection that supports aggregate throughput up to 2 GB/sec. (x8PCIe). With software compatible with existing PCI and PCI-X products, the FC-44ES uses the same device drivers as the other Celerity FC family products, simplifying installation and support.



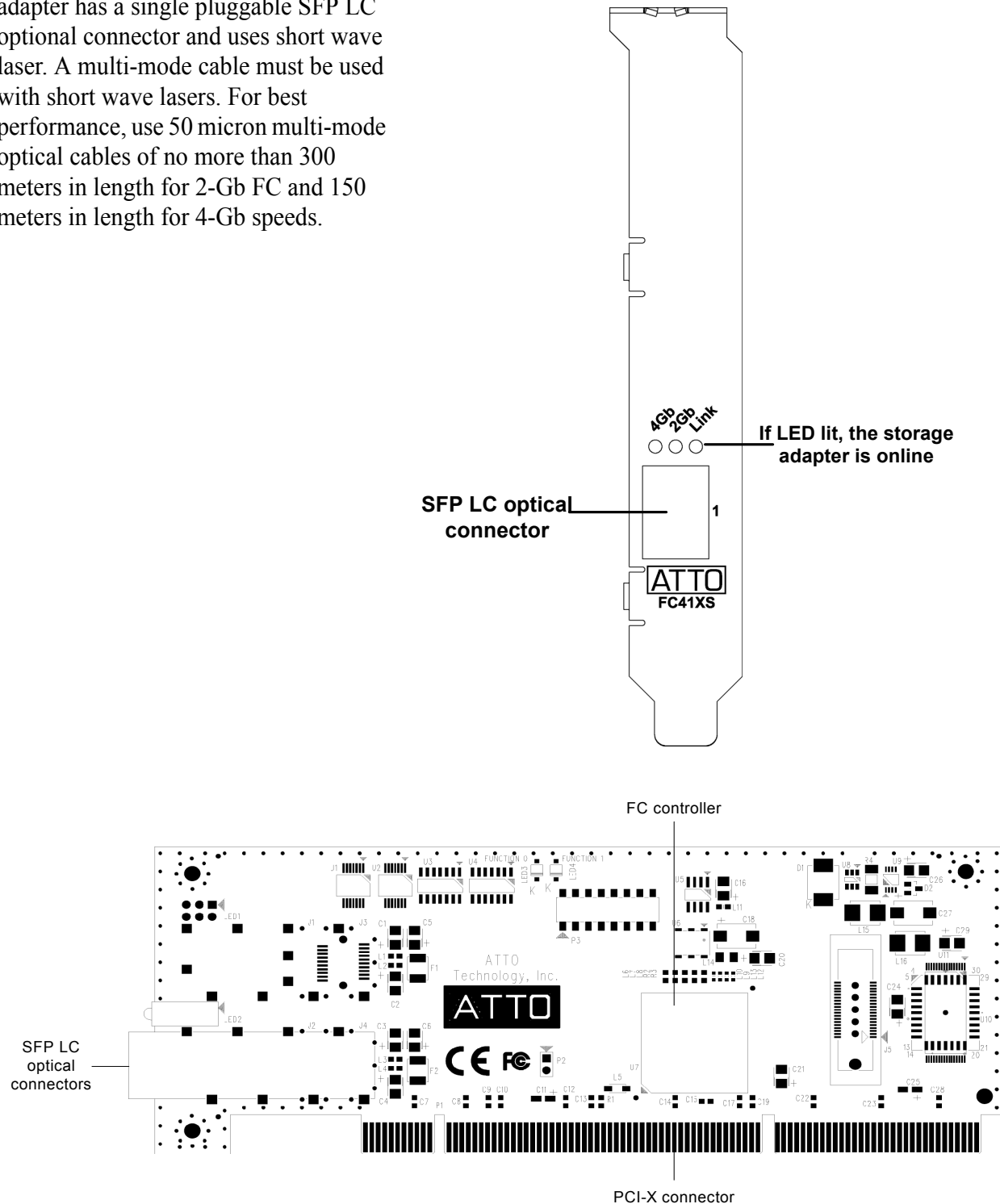
FC-42XS Adapter

The Celerity FC-42XS advanced storage adapter has two pluggable SFP LC optional connectors and uses short wave lasers. A multi-mode cable must be used with short wave lasers. For best performance, use 50 micron multi-mode optical cables of no more than 300 meters in length for 2-Gb FC and 150 meters in length for 4-Gb speeds.



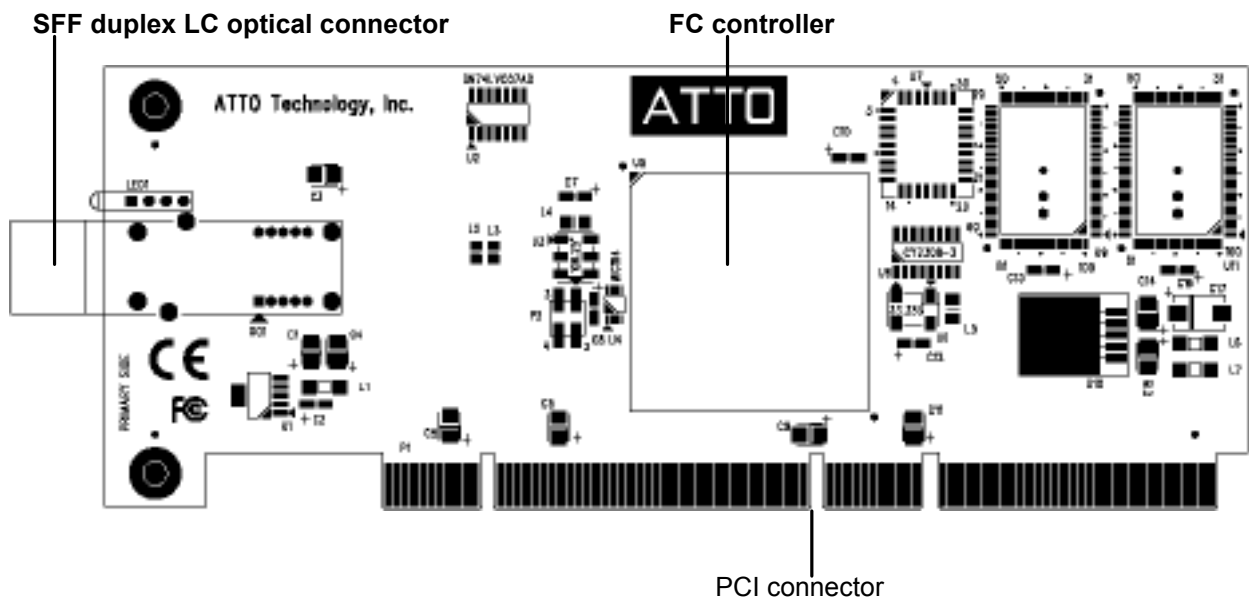
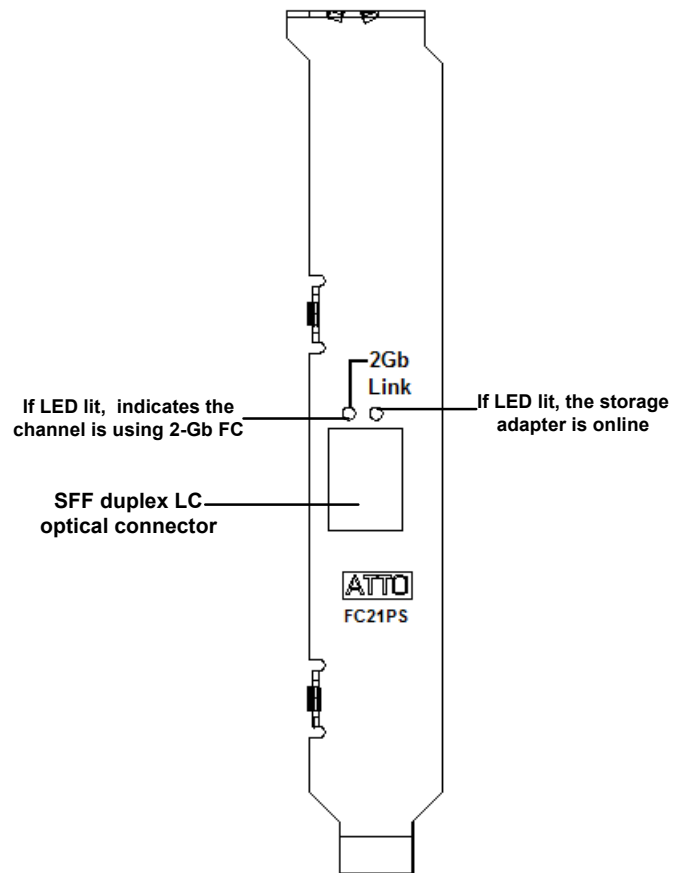
FC-41XS Adapter

The Celerity FC-41XS advanced storage adapter has a single pluggable SFP LC optional connector and uses short wave laser. A multi-mode cable must be used with short wave lasers. For best performance, use 50 micron multi-mode optical cables of no more than 300 meters in length for 2-Gb FC and 150 meters in length for 4-Gb speeds.



FC-21PS Adapter

The Celerity FC-21PS Storage Adapter has an SFF duplex LC optical connector and uses a short wave laser. A multi-mode cable must be used with short wave lasers. For best performance, use 50 micron multi-mode optical cables of no more than 500 meters in length.



FC-22XH Storage Adapter

The Celerity FC-22XH storage adapter has four pluggable SFP LC optical connectors and uses a short wave laser. A multi-mode cable must be used with short wave lasers. For best performance, use 50 micron multi-mode optical cables of no more than 500 meters in length.

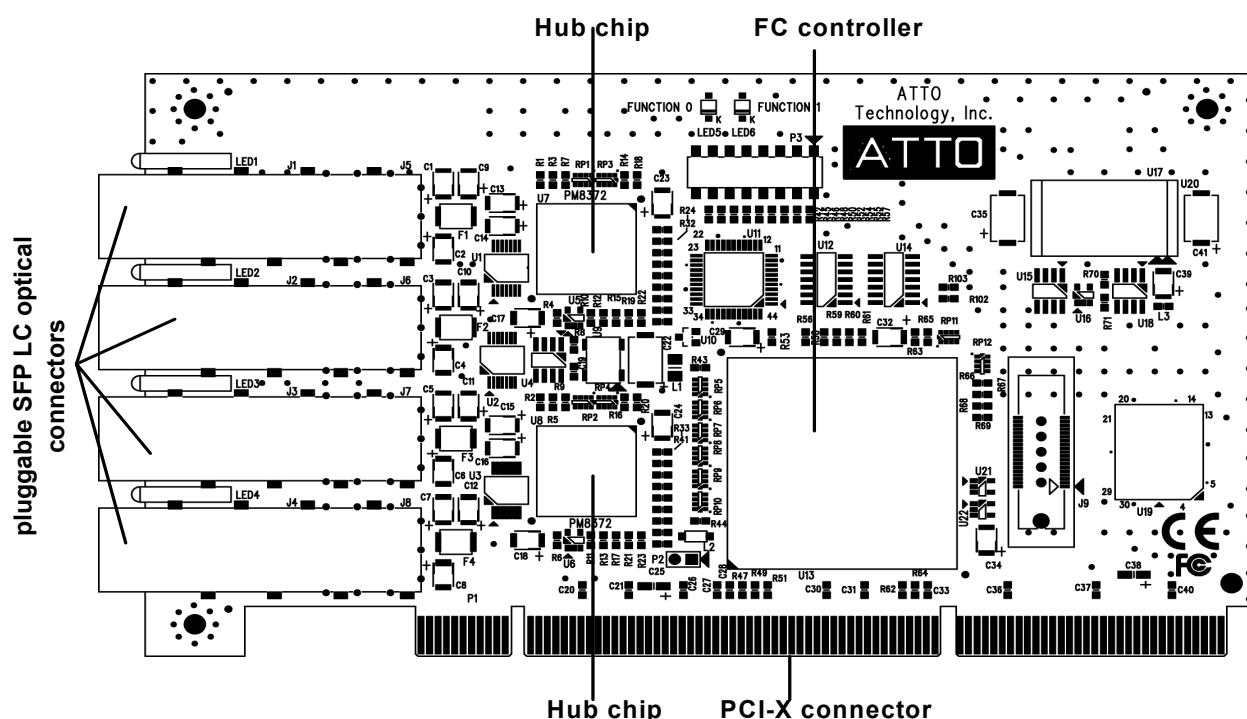
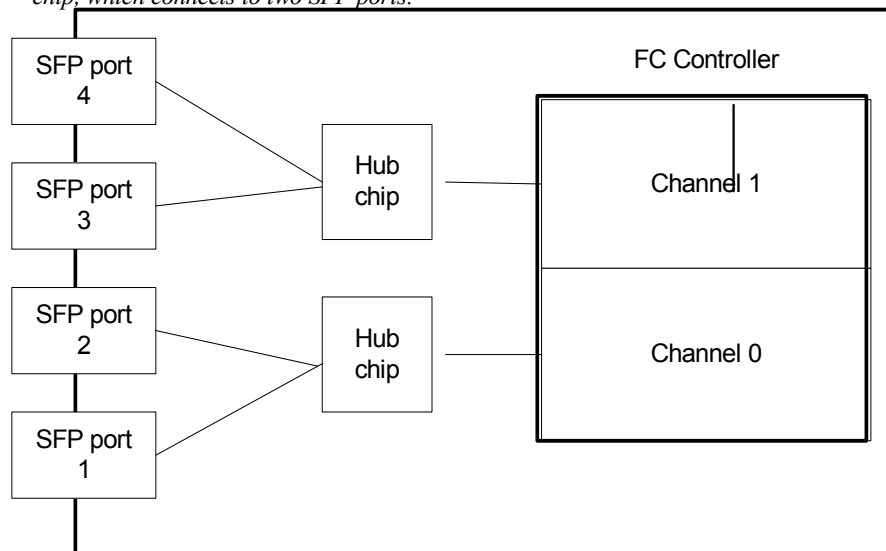
To maximize connectivity, each port on the FC-22XH is connected to one of two on-board hubs.

On-board hub

Each on-board hub chip is connected to a channel of the dual-channel Fibre Channel chip. Ports 1 and 2 of the adapter are connected through the hub chip to the first channel of the FC chip (Channel 0)

while Ports 3 and 4 are connected through the hub to the second channel of the FC chip (Channel 1). This arrangement allows you to connect four JBODs without a hub or switch. Although you

FC-22XH configuration: Each channel of an FC dual-channel chip connects to a hub chip, which connects to two SFP ports.

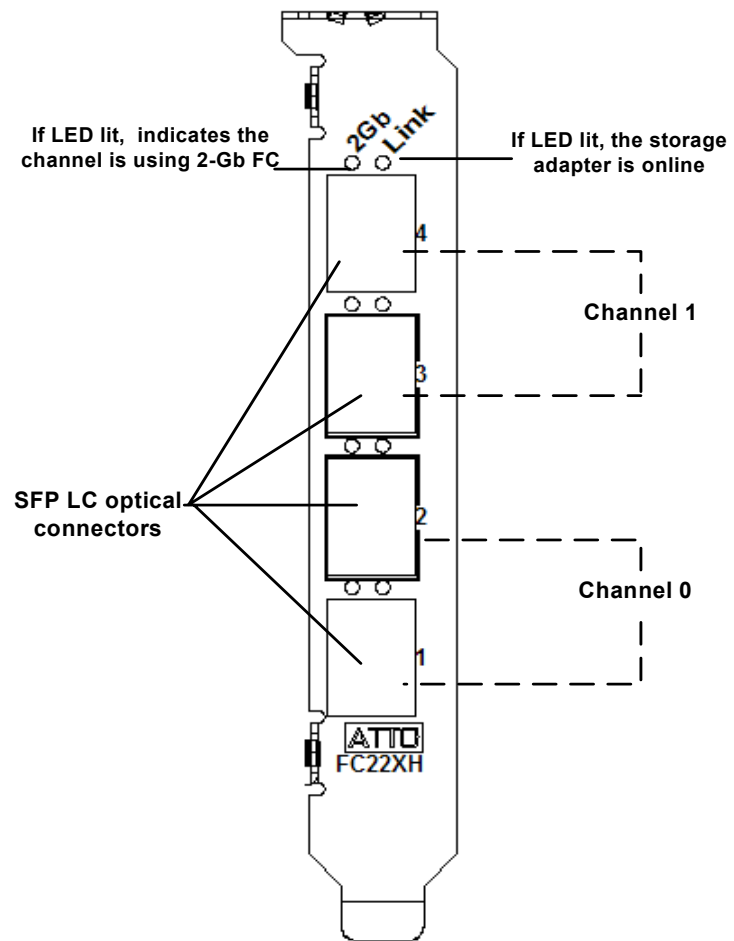


cannot connect both ports of a channel to an outside switch, you can connect one port to a switch and the other port to another device, thus daisy-chaining to make a public loop.



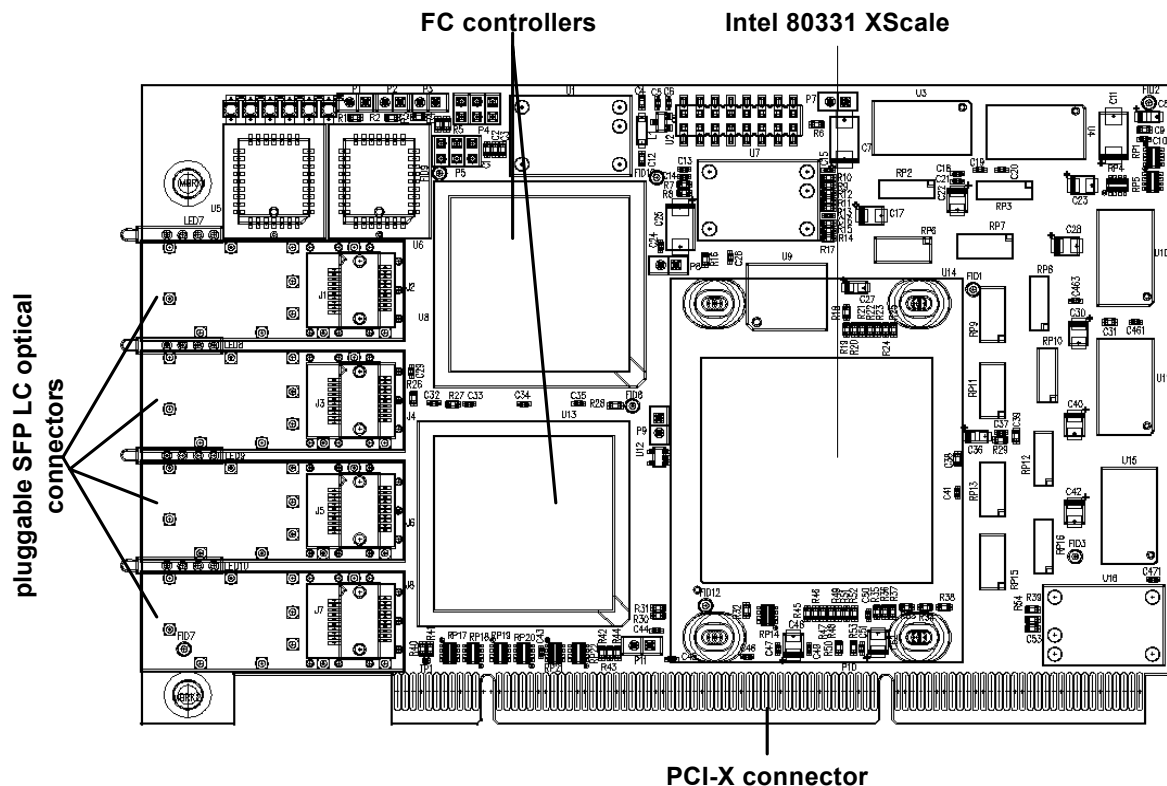
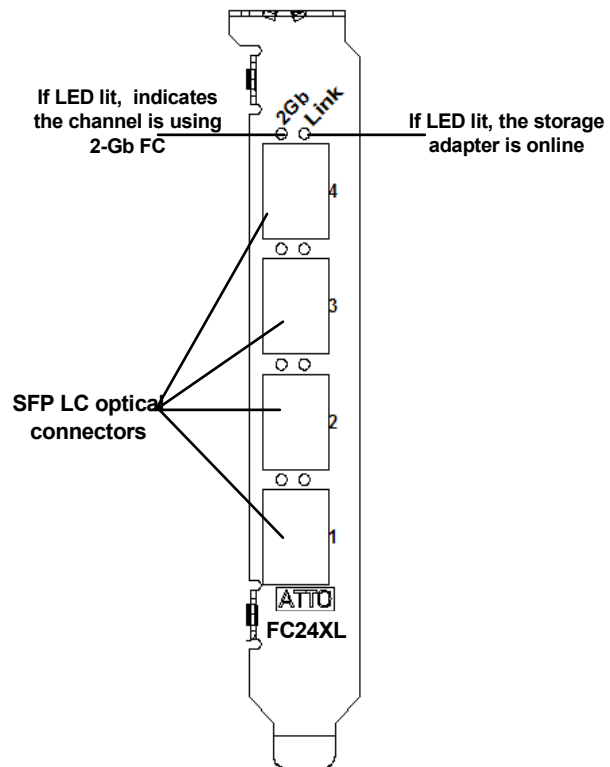
Note

The devices connected to one channel must all be the same speed: you cannot connect a 1-Gb device on Port 1 and a 2-Gb device on Port 2. However, you can connect 1-Gb devices to ports 1 and 2 and 2-Gb devices to ports 3 and 4.



FC-24XL Advanced Storage Adapter

The Celerity FC-24XL advanced storage adapter has four pluggable SFP LC optical connectors and uses a short wave laser. A multi-mode cable must be used with short wave lasers. For best performance, use 50 micron multi-mode optical cables of no more than 500 meters in length.



4 Configuring and updating drivers

Celerity FC storage adapters require a current device driver and hardware flash for proper operation. Your adapter was properly flashed before shipment, but the flash memory may need to be updated as new versions become available or if the factory-installed version becomes corrupt. This chapter deals with installing and updating device drivers. Refer to [Updating hardware flash](#) on page 24 for information on updating hardware flash. Visit the ATTO web site, www.attotech.com, to download the latest drivers and flash bundle.

Initial configuration

While the factory settings on your Celerity FC storage adapter should provide excellent performance for a wide range of applications, some specialized applications may benefit from modification of adapter settings. The ATTO Utilities Installation and Operation Manual provides detailed information on using ATTO Technology configuration utilities found on the ATTO Utilities CD or downloaded from the ATTO website.

For best performance, use the most recent device driver and flash version.

To verify the version:

Windows: Use the ATTO Configuration Tool from the ATTO Utilities CD, or downloaded from www.attotech.com, or use a combination of the

adapter boot string during system boot and the Device Manager.



Note

Windows NT is only supported with Celerity driver version 1.31 or earlier. If you are using Windows NT, contact your service representative.

Mac OS X: Use the ATTO Configuration Tool on the ATTO Utilities CD, or downloaded from www.attotech.com, or use the Apple System Profiler.

Linux: Use the ATTO Configuration Tool on the ATTO Utilities CD, or downloaded from www.attotech.com, or to find the driver version, examine `/proc/scsi/celerityfc/X`, where X is the adapter's host number.

Windows 2000/XP/Server 2003

Five procedures are described below. Review each thoroughly to ensure that you are using the one that best fits your needs.

If you have one or more Celerity FC adapters installed in your system and you are installing additional adapter(s), you do NOT need to perform any of these procedures unless you are updating a previously installed driver. The Celerity FC Installation Disk can be the Installation CD shipped with your adapter, a folder containing the latest downloaded and expanded driver, or a Celerity FC installation floppy disk.

The Installation CD automatically starts when inserted in the system CD-ROM drive. Navigate the easy-to-use HTML-based menu to find the driver that you want to install. If the CD does not automatically start, use Explorer and run **autorun.bat**.

Upgrading your existing Celerity FC driver

- 1 Log on to Windows as the System Administrator.
- 2 Insert your Celerity FC Installation Disk and run **autorun.bat**
- 3 In **Windows Drivers**, select your operating system and **Install Driver**.

Adding a Celerity FC adapter to an existing Windows installation



Note

Complete this installation procedure before attaching any devices to the adapter.

- 1 Complete the steps in [Upgrading your existing Celerity FC driver](#) on page 21 to pre-install the driver.
- 2 Shutdown Windows when **Setup** prompts you to do so.
- 3 Install your new Celerity FC adapter into an available PCI expansion slot.
- 4 Restart Windows. During the boot process, Windows detects your Celerity FC adapter and the **Found New Hardware Wizard** is displayed.
- 5 Use the default settings for each adapter channel.
- 6 Insert the Celerity FC Installation disk when asked to do so.
- 7 When adapter installation is complete, the **Found New Hardware Wizard** displays an **ATTO Phantom Device** for each channel. Use the wizard default settings to complete the installation.
- 8 Shut down the system and set up the final adapter configuration.
 - a. If the Celerity FC adapter is replacing another adapter in the system, disconnect the FC cables from the adapter and remove the adapter from the system, or you can move the Celerity FC adapter to the PCI slot that the previous adapter occupied if this slot is more suitable for the Celerity FC adapter.
 - b. Attach the appropriate FC cables to the Celerity FC adapter.
 - c. Close the computer chassis, turn on the power and restart Windows.



Note

*If you moved the adapter to a different PCI slot, the **Found New Hardware Wizard** displays. Proceed through the wizard with*

the default settings for each adapter channel to complete the installation.

Install a fresh copy of the Windows OS onto a disk attached to the Celerity FC adapter



Note

The Celerity FC driver does not support boot functionality on Itanium systems; therefore, the procedure described below does not apply to Windows Server 2003 for Itanium systems.

- 1 Start Windows text mode setup as per the instructions provided with Windows.
- 2 Press **F6** when the first blue window, called **Windows Setup**, displays.

The setup program displays a prompt in the status window on the bottom left of the monitor. Setup continues to load files after you press **F6**.
- 3 A new window displays instructions to specify additional mass storage devices. Press **S** indicating that you wish to install a storage device.
- 4 Insert the Celerity FC installation diskette in **drive A:** and press **Enter**.
- 5 A screen displays a list of Celerity FC adapters. Select your adapter and press **Enter**.
- 6 Windows Setup loads the files from the floppy and then displays the screen described in step 2. The **ATTO Celerity FC** device should now be listed as detected.
- 7 Repeat steps 2 - 4 for any other vendor-supplied driver installation disks.
- 8 After all other drivers have been processed, press **Enter** and proceed with the rest of the Windows Installation procedure.



Note

When Windows begins copying files to your hard disk, a display prompts you to insert the Celerity FC installation disk and any other vendor-supplied disks you used during custom installation. This is normal. The first time you inserted the disks, Windows only loaded the drivers into memory; the second time you insert the disk(s), Windows is copying the driver to your hard disk.

Create a Celerity FC installation floppy disk from the Celerity FC Installation CD



Note

You must have a floppy disk with the Celerity FC driver software to install a fresh copy of the Windows OS onto a disk attached to a Celerity FC adapter.

- 1 Insert the Installation CD into a CD-ROM. The installation starts automatically start. If the Celerity FC installation does not start, navigate to the root of the CD and run **autorun.bat**.
- 2 Select **Windows Drivers** from the items on the left side of the screen.
- 3 Select the appropriate CPU-based operating system from operating system choices.
- 4 Select **Create Miniport Driver Diskette** or **Create StorPort Driver Diskette** for the desired operating system.
- 5 Follow the instructions for creating the floppy disk.

Create a floppy disk from a Celerity FC driver download from the ATTO Technology website

- 1 Download the latest driver software from the ATTO web site, www.attotech.com.
- 2 The download is a self-extracting executable that expands the driver software package. Run the self-extracting executable and select a folder to place the expanded software package.
- 3 Navigate to the folder with the desired Celerity FC driver.



Note

The expanded software package contains a Miniport driver and may contain a StorPort driver. The Celerity FC Windows Miniport driver is in the base directory of the expanded software package. The Celerity FC Windows StorPort driver is in the StorPort subdirectory.

- 4 Run **makedisk.bat** and follow the instructions for creating the floppy disk.

Mac OS X driver installation, update

New or previous installation

- 1 Extract the latest version of the device driver file to your desktop.
- 2 Double click the installer icon and follow the on screen prompts
- 3 Reboot your system for the changes to take effect.

Linux driver installation, update

New or previous installation



Note

You must have kernel header files for the appropriate kernel installed.

*You must be logged in as **root**.*

- 1 If updating an existing Celerity FC driver, at the command prompt type **rmmod celerityfc**
- 2 Download the appropriate version of the device driver from the ATTO web site.
- 3 At the command prompt, extract the file using the command **tar -xzf <filename.tgz>**
- 4 Enter the directory created in the above step and type **make install** to overwrite any previously-installed driver.
- 5 Start the driver by typing **modprobe celerityfc**

5 Updating hardware flash

Your Celerity FC storage adapter was properly flashed before shipment, but the flash memory may need to be updated as new versions become available or if the factory-installed version becomes corrupt. Visit the ATTO website, www.attotech.com, to download the latest drivers and flash bundle.

To update hardware flash in all operating systems

- 1 Download the most recent version of the **Configuration Tool** from the ATTO web site, www.attotech.com.
Refer to the **ATTO Utilities Installation and Operation Manual** for additional information on downloading and using the **Configuration Tool**.
- 2 Download the proper flash bundle (adapter specific) from the ATTO web site.
- 3 Extract these files to your desktop.
- 4 Install the **Configuration Tool** on your system.
- 5 Launch the **Configuration Tool**.
- 6 In the **Device window**, select the adapter that needs to be updated.
- 7 In the **Flash window**, click on the **Browse** button to find the flash bundle that you previously downloaded to your desktop.
- 8 Click **Update** to update your flash ROM.
- 9 Reboot your system for the flash changes to take effect.

To update hardware flash on a PC using the BIOS utilities



Note

BIOS utilities do not work on Itanium systems. Use the ATTO Configuration Tool to update flash on Itanium systems.

- 1 Download the latest driver software from the ATTO Technology website.
- 2 The download is a self-extracting executable that expands the driver software package. Run

the self-extracting executable and select a folder in which to place the expanded software package.

The expanded software package contains a Miniport driver and may contain a StorPort driver. The **Celerity FC Windows Miniport** driver is in the base directory of the expanded software package. The Celerity FC Windows StorPort driver is in the **StorPort** subdirectory.

- 3 Navigate to the folder with the desired Celerity FC driver.
- 4 Run **makedisk.bat** and follow the instructions for creating the floppy disk.



Note

The flash update must be loaded from a floppy because CD-ROM drivers are not loaded at this point in the system boot process.

- 5 Reboot the PC.
- 6 During the reboot, an ATTO Technology banner displays that the storage adapter was detected.
- 7 Enter **Control-F** when prompted to begin the set-up utility within a few seconds after the banner appears.
If you do not enter Control-F soon enough after the banner appears, repeat steps 5 and 6.
- 8 In the utility, select the **Upgrade Flash ROM** option.
- 9 Insert the disk into the drive slot.
- 10 Follow the on-screen instructions.
- 11 Remove the disk and reboot your system for the flash ROM changes to take effect

6 Troubleshooting

This chapter contains solutions for the most common problems you might encounter. If you need additional assistance, please refer to the ATTO Technology web site (www.attotech.com) or contact an ATTO Technology authorized representative.

General suggestions

- Check each cable connection on every device.
- Verify all cables are in proper working condition. Loose or broken cables are often the cause of errors or problems.
- Check that Fibre Channel devices are plugged into an AC outlet and are turned on before you add power to your computer.

Mac OS X



Note

The Celerity FC supports Mac OS X versions 10.3 and later.

If devices are not accessible

- 1 Open the ATTO **Configuration Tool** from the ATTO Utilities CD or download from the ATTO website. Refer to the *ATTO Utilities Installation and Operation Manual* for additional information.
- 2 If the adapter does not appear in the **Device Listing**, make sure it is properly seated in the PCI slot.
 - a. Remove power from the PC.
 - b. Remove the case.
 - c. Check the PCI slot.
 - d. Replace the case.
 - e. Apply power.



Note

If it is properly seated and devices are still not accessible, contact an ATTO Technology authorized representative.

- 3 Verify the driver is loaded.

- a. Click on the adapter name in the **Device Listing** to view the **Basic Info** screen.
 - b. If the **Driver Information** section indicates **Unknown: driver not loaded**, reinstall the driver. Refer to [Configuring and updating drivers](#) on page 21.
 - c. If reinstalling the driver does not fix the problem, contact an ATTO authorized representative.
- 4 Reset the NVRAM for all channels to defaults and reboot. If the problem persists, contact an ATTO authorized representative.



Note

When calling ATTO Technical Support, please have a printout of the IOREG listing and output from the Apple System Profiler available.

Windows 2000/XP/Server 2003

- If the card has been recently re-flashed, the new Windows driver must be installed. Follow the procedure in [Configuring and updating drivers](#) on page 21.
- All of the external devices connected to the storage adapter should be identified. If they do not appear in the **Device Manager**, the external devices or connection may not be working properly.
- For Intel-based PCs, check the computer CMOS setup and verify that the PCI slots are configured correctly.
- Procedures vary greatly: refer to the manual supplied with your system or call the computer supplier for configuration assistance.
- Windows 2000/XP/Server 2003 are Plug-n-Play operating systems: be sure your computer's BIOS is set accordingly.

- If these do not solve the problem, re-flash the storage adapter and re-install the Windows 2000/XP/Server 2003 driver. See [Configuring and updating drivers](#) on page 21.

If the devices connected to the Celerity FC storage adapter are not accessible

- 1 Right-click **My Computer**.
- 2 Select **Properties**.
- 3 Select the **Hardware** tab
- 4 Select **Device Manager**.
- 5 If the Celerity FC storage adapter does not appear under the SCSI and RAID controllers, shut down and make sure the Celerity FC storage adapter is properly seated in the PCI slot.

- a. Remove power from the PC.
- b. Remove its case.
- c. Check the PCI slot.
- d. Replace the case.
- e. Apply power.

- 6 Reload the driver (see [Configuring and updating drivers](#) on page 21).
- 7 If the adapter has been identified but there is an exclamation point (!) on the listing, right click on the listing and select **Uninstall**.
- 8 Reboot the system and repeat the installation process.
- 9 If problems persist, contact your authorized ATTO Technology representative.

Linux

- 1 Verify the **celerityfc driver** is loaded with the **lsmod** command. If **lsmod** does not show the driver, refer to the installation instructions to install and load the driver in [Configuring and updating drivers](#) on page 21.
- 2 Check the system log with the command **dmesg**. The celerityfc driver creates status messages during initialization. Make sure that all installed cards are properly detected and initialized.
- 3 Examine the contents of the file(s) **/proc/scsi/celerityfc/X**, where X is the

adapter's host number. This file contains details such as link status, connection speed and discovered devices.



Note

*Advanced users only. Modify the **driver makefile** to enable debugging information. Upon loading, the **celerityfc driver** displays detailed debugging information which may help troubleshoot the problem.*

Appendix A Standards and compliances

The equipment described in this manual generates and uses radio frequency energy. The Technical Specification sheet for a particular Celerity FC storage adapter list certifications for that model.



FCC standards: radio and television interference



WARNING

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help



Canadian standards

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.



European standards

Declaration of Conformity

This following statement applies to the Celerity FC storage adapter.

This device has been tested in the basic operating configuration and found to be compliant with the following European Union standards: Application of Council Directive: 89/336/EEC

Standard(s) to which conformity is declared: EN55024:2002; EN55022:2002 CLASS B

This Declaration will only be valid when this product is used in conjunction with other CE approved devices and when the entire system is tested to the applicable CE standards and found to be compliant.

Usage restrictions

The use of optical instruments with this product will increase eye hazard.

The multimode transceiver is a Class 1 laser product complying with IEC 825-1 and FDA-21 CFR 1040.11. To meet laser safety requirements, the transceiver shall be operated within the maximum ratings. The laser is non-OFC compliant as it is a Class 1 device.

The optical ports of the modules must be terminated with an optical connector or with a dust plug.



CAUTION

Failure to adhere to the above restrictions could result in a modification that is considered an act of “manufacturing” and will require, under law, recertification of the modified product with the U.S. Food and Drug Administration (ref. 21 CFR 1040.10(i)).

Appendix B Accessories

The following Fibre Channel accessories are available through ATTO Technology and authorized resellers. Contact an ATTO Technology authorized sales representative to order.

Optical Cables

CBL-FCFI-05x	5 m. cable– Duplex 50 Micron Multi-mode FC/Optical
CBL-LCSC-003	3 m. 50/125 optical cable (LC to SC)
CBL-LCSC-010	10 m. 50/125 optical cable (LC to SC)

A variety of iSCSI, Fibre Channel and SCSI products are also available from ATTO Technology. Please contact your ATTO sales representative for product descriptions and part number information.

Fibre Channel and iSCSI solutions

ATTO FibreBridge™	Fibre Channel-to-SCSI bridge
ATTO FibreCenter™	Fibre Channel Hub
ATTO iPBridge	iSCSI to SCSI, iSCSI to Fibre Channel bridges

SCSI solutions

ATTO ExpressPCI Family of SCSI Host Adapters (see Appendix C)

Software

ATTO Utilities	Configuration and management software
ATTO ExpressStripe for OSX MacOS X RAID and benchmark software	

Appendix C SCSI adapter selection guide

	Ultra 320		Ultra 160	
Product Features	UL4D	UL4S	UL3D	UL3S
Maximum Transfer Rate (MB/sec.)	640	320	320	160
Low Voltage Differential	✓	✓	✓	✓
High Voltage Differential				
Single-ended SCSI	✓	✓	✓	✓
Number of SCSI channels	2	1	2	1
Number of SCSI IDs supported	30	30	30	30
Cable distances (m)	12.5	12.5	12.5	12.5
32-bit PCI compatible	✓	✓	✓	✓
64-bit PCI compatible	✓	✓	✓	✓
33 MHz PCI	✓	✓	✓	✓
66 MHz PCI	✓	✓		
133 MHz PCI-X	✓	✓		
Windows NT/200/XP/95/98 support	✓	✓	✓	✓
Linux	✓	✓	✓	✓
Mac OS 9 & Mac OS X support	Mac OS X	Mac OS X	✓	✓

Appendix D Contact ATTO Technology, Inc.

Customer service, sales information and technical support are available by phone Monday through Friday, Eastern Standard Time 8:00 a.m. to 8:00 p.m., or by e-mail and web site 24-hours a day.

ATTO Technology, Inc.
155 CrossPoint Parkway
Amherst, New York 14068
(716) 691-1999 • voice
(716) 691-9353 • fax
<http://www.attotech.com>

ATTO Technology can also be reached via e-mail at the following addresses:

<i>Sales Support:</i>	sls@attotech.com
<i>Technical Support:</i>	techsupp@attotech.com